

## Understanding Values, Cognitive, Political and Social Aspects of European Industry 5.0

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Debates about industrial revolutions usually begin with technological advancements, move on to economic effects and then proceed to broader social, political, cultural and environmental contexts. Some kind of technological determinism was at least implicitly present in these concepts: a new technology solution is invented and implemented – and people, society and culture are supposed either to adapt to it or to perish.

The first industrial revolution or Industry 1.0 brought forward one of the most profound changes in human history – replacing the old agrarian society and the remnants of feudalism with industrial capitalism. Industry 2.0 that followed provided all the key sources of energy we still rely on today: electricity and fossil fuels – even the uses of solar and nuclear energy are at least rooted in this period. Every road vehicle of today – from internal combustion to battery electric cars – all the classical mass media – from radio to television – and most of the synthetic materials owe their core features and functionalities to Industry 2.0. The same can be claimed for assembly lines and mass consumption.

While Industry 2.0 brought forward a diversity of inventions unprecedented in the recorded history, Industry 3.0 and 4.0 were much more focused around a single trend that proceeded in an unprecedented speed: digitalisation. It created computers, automated factories and internet within Industry 3.0 and the subsequent cyber-physical fusion of the industry 4.0.

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Unlike the previous industrial revolutions based on people, society and environment adapting to technological and economic changes, Industry 5.0 is not so much about revolutionary new technologies but more about upgrading and adapting technological solutions from previous industrial revolutions to the human needs, sustainable co-existence with other living beings and resilience for potential disruptions (Nerkhede et al 2025). It is primarily value-driven rather than technology driven (Rejeb et al 2025). The reason for this major paradigmatic shift is two-fold: because it is *possible* and because it is *necessary*.

The very clear focus on digitalisation within Industry 3.0 and 4.0 has made changes very rapid but also at least slightly more predictable. It seems much clearer at least *where* – i.e. in which fields – major changes can be expected and on which technological basis. This allows policies and actions that are less reactive and more proactive. The other reason why this kind of policies have become more possible is based on the regulatory potentials of the European Union. Its previous successes as well as failures have contributed to significant level of collective learning about the potentials and traps of regulation. This vast experience can provide the potential for Europe to develop as the leader in Industry 5.0 – a global example to be followed when it comes to human-centric, sustainable and resilient production and services.

However, it is not so much a matter of choice but even more a matter of necessity. The results of industrial revolutions so far have not only led to unprecedented prosperity for unprecedented numbers of people but also to enormous price that continues to be paid by people, other biological species, the environment in general – industry has remained unsustainable in the long run and overly exposed to a huge variety of risks. Classical warnings about alienation (Marx), anomie (Durkheim), iron cage (Weber) have retained a lot of their original relevance and have been upgraded with new sociological insights about distorted communication (Habermas) and social acceleration (Rosa). Destructive environmental effects rooted in Industry 1.0 and especially 2.0 have not ceased with subsequent 3.0 and 4.0 digitalisation.

On the top of that, expected further developments in the fields of artificial intelligence and synesthetic biology will lead to unprecedented changes. If Industry 3.0 and partly also 4.0 have been relatively narrowly focused on digitalisation, it is expected that the scope of what is to follow would be both deeper and broader (Suleyman and Bhaskar 2023). The achievements of previous industrial revolutions will be revisited through the development of new materials, new and smarter ways of optimising production, storage and distribution of energy, new solutions to move and communicate in combined physical and virtual spaces, smarter and more targeted medical interventions, new potentials for connecting and reorganising biological, psychological and technological features. These features will provide unprecedented opportunities to save humanity and provide its

sustainable coexistence with the rest of the planet. On the other hand, unprecedented threats to destroy the civilisation or even the humanity as such.

With this edited monograph, we emphasize that the core vision of European Industry 5.0 lies above all in a holistic perspective—one that foregrounds not only technological systems and innovation, but also awareness of the deep interconnectedness of the planetary system, which necessarily includes the technological domain. If we imagine losing access to natural resources, or if we take away all the components that enable technological devices to function, we are left with nothing. Moreover, the human existence depends on the air we breathe and require food to eat. The central idea lies in the interweaving of all environments and systems, namely the human, social, natural, and technological ones - because if we truly understand this interconnectedness, responsibility, sensitivity, ethics, and resilience on all social level follow automatically, and our practices can change.

At the level of individuals, the personal autonomy, integrity, and agency remain important, but they must be situated in the awareness of co-dependence and cooperation. At the same time, this is not merely an individual matter; it must also be transferred to other levels. The vision of European Industry 5.0 emerges from the macro environment, and it is still evolving. Not so much in terms of conceptualization, but above all because of implementation, which is a demanding task. Industry 5.0 is far from being a monolithic concept and entails different dimensions, which are implemented variously on different social levels and social contexts.

And the book addresses this challenge by enveloping interdisciplinary and multi-case perspective based on concrete conceptual and empirical examples, showing how the European Industry 5.0 principles can be implemented across various sectors such as digital services and media literacy, education, circular economy. It considers the advantages of the technological development that have merged the social spaces, facilitated the interactions and knowledge transfer.

The people are bound to each other as they have never been in the past, with opportunities that can lead to a more harmonious and better life for all living beings. However, there is a need for thorough changes in practice on all social levels that book addresses. By that, it contributes to the contemporary debates not only on industrial transformation but even more on the societal, and value orientated. While well-coordinated supranational regulation – as provided by the European Union – is essential for Industry 5.0, it would be a grave mistake to rely solely on top-down and centralised approaches. Instead, bottom-up, localised, decentralised and community-based actions are required. This is the central emphasis on this book.

## Structure of the book

Since Industry 5.0 is above all value-based, the first part of this book proposes the value core for Industry 5.0 – to focus on humanity seeing it as an integral part of Earth. The chapter by Tea Golob and Matej Makarovič thus presents planet-centred awareness as the basis of ultimate concerns for both bringing humanity together and connecting it to the whole planet. This awareness is based on well-established facts about our planet as an all-encompassing system of living species and their environments deeply interdependent from each other. However, it runs counter some two deeply rooted ideological divisions: overemphasising the distinctions between us and them in human communities and seeing humanity as being separated from the natural world. Industry 5.0 and any positive prospects for humanity and human civilisation are only conceivable if these divisions are overcome. Nevertheless – this would be impossible if planet centred awareness becomes simply a new religion as this would only generate new distinctions between the believers and non-believers. Therefore, the chapter on planet-centred awareness introduces its crucial relationship with meta-reflexivity. The value basis of Industry 5.0 cannot be based on any kind of blind faith but on persisting critical and self-critical (inner) dialogues required to develop, maintain and elaborate planet-centred values.

Critical reflexivity related to Industry 5.0 is inconceivable without knowledge. The second part of the book thus addresses the cognitive basis of Industry 5.0: selected aspects of production and distribution of knowledge. The chapter by Maruša Gorišek focuses on the complex relationships between scientists, politicians and general public. Through the analysis of partnerships within the Association of Municipalities and Towns of Slovenia (Skupnost občin Slovenije), she discovers that local communities possess significant potential for collaboration among all three actors and addresses the potentials of deliberative democracy at the local level. The latter are strongly conditioned by proper organisation and well-informed citizens.

As the prevalence of the latter is far from self-evident, the chapter by Mateja Rek reveals a fundamental gap between current media education practices and the requirements for Industry 5.0. Media education must move beyond teaching functional digital skills toward developing "meta-reflexivity"—critical self-reflection enabling individuals to question algorithmic influence, understand encoded values in data systems, and recognize broader socio-economic forces structuring digital environments. Industry 5.0 emphasis on human-machine collaboration demands citizens capable of ethically co-creating with intelligent systems rather than passively consuming content.

The need for co-creation calls for different teaching and learning approaches. A viable way in this regard is presented by Klavdija Zorec. She studies the cases of student-led work-integrated problem-based learning at the Faculty of Information Studies. Her results demonstrate that problem-based learning – when authentically embedded in community

contexts – can both enhance student development and generate tangible solutions to real societal challenges. The model offers a transferable approach for higher education institutions seeking to strengthen local engagement, support digital and green transitions in underserved areas, and cultivate socially responsible graduates equipped for complex professional environments.

The third part of the book is focused on the political visions and political contexts of Industry 5.0. It begins with the chapter by Alenka Pandiloska Jurak who explores the presence of human-centricity, sustainability and resilience as its core pillars in the macro-regional strategies in the Baltic Sea Region, Adriatic Ionian Region, Danube Region, and Alpine Region. She notes terminological inconsistencies across macro-regions that complicate policy evaluation, obscure fund allocation tracking, and undermine systematic assessment of the EU industrial policy implementation. She calls for measurable indicators of Industry 5.0, further alignment of macro-regional objectives with the EU industrial policy and promoting capacity building through upskilling, digital innovation hubs, and cross-border research collaboration.

The implementation of Industry 5.0 may be seriously hampered by deficiencies in political legitimacy – as addressed in the chapter by Matevž Tomšič. Leadership vacuum, problem-solving failures, declining trust and deficiencies in common European identity may be a serious obstacle when confronting external authoritarian threats and internal destabilising forces, such as populism, political extremism and ideological divisions. He advocates going beyond both centralist and sovereigntist approaches and instead base the policies on thoughtfully allocating responsibilities across European, national, and local levels while demonstrating genuine leadership addressing citizen concerns.

The multi-level approach to governance for Industry 5.0 is further elaborated in the chapter by Tamara Besednjak Valič, Erika Džajić Uršič and Janja Lozar. They examine how multi-level stakeholder governance enables or constrains rural bioeconomy development aligned with the Industry 5.0 principles in Slovenia, Montenegro, and Baden-Württemberg. They identify the need for institutions capable of implementing rather than merely formulating strategies, stable cooperation networks persisting beyond project cycles, and trust-based collaboration with inclusive cognitive frames valuing local expertise. The rural bioeconomy cannot rely on technology or markets alone. It requires sustained cooperation, embedded human-centric values, and translating strategic ambition into durable regional transformation consistent with inclusive sustainable development.

In the final part of the book, the chapters are focused on the community well-being – through selected human centric features of the emerging Industry 5.0. Jana Krivec and Tjaša Stepšnik Perdih focus on the significance of psychological safety as experienced at the individual level. They demonstrate that psychological safety is not merely an

organizational or team-level construct but a broad, socially embedded phenomenon extending beyond workplace boundaries. Creating genuinely human-centred work environments requires attention not only to organizational practices but also to employees' broader social contexts, material security, and personal well-being—acknowledging the inseparability of work life from community and personal life.

The same two authors then elaborate on the use of Field-Development-Demands (FDD) Loop as an integrated framework operationalizing Industry 5.0's human-centric vision. Their framework distinguishes between horizontal development (expanding skills) and vertical development (qualitative transformation in meaning-making). Human Digital Twins serve as active regulators operating across four functional layers: sensing, modelling, simulation, and adaptive. They demonstrate that human-centric transformation is achievable through theoretically grounded, culturally sensitive, ethically governed frameworks combining psychological science with adaptive technology.

The integration of psycho-social and technological aspects is also analysed by Anja Janko who focuses on how virtual reality (VR) simulations of stressful school scenarios can help children confront anxiety-provoking situations in safe, controlled environments. A pilot study involving students with high anxiety found that 65% of students no longer felt anxious about starting at a new school after VR therapy. The author argues that VR represents a transformative step in child mental health care, combining proven exposure therapy principles with developmentally appropriate, engaging technology. With proper professional supervision and ongoing research, it can become a standard component of preventive and therapeutic mental health services in schools.

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